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Land Use Changes in Peri-Urban Open Spaces of Small Towns in Eastern Hungary

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Abstract: Changes in land use were studied in 2 km wide peri-urban open spaces of seven small Hungarian towns as part of a RENATUR Interreg Europe (2019–2023) project. The aim of the project is to present best practices related to the sustainable and wise use of the peri-urban open spaces of small European towns. The rate and tendencies of conversion from one land use type to another were evaluated on the basis of a comparison of Corine Land Cover and Land Cover Change databases from 1990, 2000 and 2018. Land use changes in the study areas in different time periods were studied for which the Corine categories were aggregated. Subsequently, there were field verification surveys carried out between March and June of 2021. Most significant changes—due to the significant increase of built-up areas—were found in the case of the towns that were developed to form the suburbs of Debrecen, the core settlement of their region with a population of 200,000. In the case of settlements further away from the major city, the population is either stagnating or decreasing, and the size of built-up areas hardly increases. In the case of cities that are surrounded by high-quality chernozem soils with profitable agriculture, large-scale arable lands have become dominant in the border zones of the settlements, as the spatial extent of gardens, orchards and grasslands has decreased. Highly diverse and mosaic land use (dominated by small plots) is not characteristic anywhere.

Keywords: land use change; peri-urban zone; landscape identity; Eastern Hungary

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1. Introduction

Conversion of land use in peri-urban open spaces is among the most dynamic geographic processes [1–4]. Although covering the land with buildings further away from settlements for recreational or transportation use has been increasing since the mid-20th century, conversion of land use has been concentrated in the vicinity of settlements until the present [5–11].

There was an increase of approximately four times in the extent of built-up surfaces since the First Military Survey of Hungary was carried out between 1782 and 1785; therefore, this category gives 7% of the area of the country today. Although the process is affected by numerous natural, political, economic, technological and cultural factors, according to the literature, there are also similar processes and proportions abroad [12–14].

According to Szilassi P. (in: Ref. [15]), between 1990 and 2012, the surface cover type was changed in 10% of the area of the country, which is higher than the EU average. Land use realignment processes that had started before have been accelerated since 1989/90 in the so-called Visegrad Group of countries of the EU [16–20]. The proportion of artificial surface cover was 6% in Czechoslovakia (the independent Czech Republic and the Slovak Republic from 1993) in 1990, similar to Hungary, and it has now reached 7–8%. This proportion was 3.3% in the larger and less densely populated Poland in 1990, and it has now reached 5.5% [21]. The spatial ratio of artificial surface cover and forests has been increasing in all

four countries, while the extent of arable lands was decreasing. The dynamic increase in the proportion of artificial surface cover was mainly generated by massive suburbanization, riverbank recreation and greenfield industrial investments [22,23]. Nevertheless, national statistical averages can veil big regional differences within the countries. The increase in artificial surface cover is below average in hilly regions of the Czech Republic and the Slovak Republic, while there has been a significant increase in artificial surface cover in the non-agglomeration zones in Poland after 1990. This latter can be explained partly by some technical issues. The structure of small plots of land and farms that survived the decades of socialism in Poland showed such a dense pattern of built-up areas over arable lands in many regions by 1990, which was remotely sensed as artificial surface cover in Corine Land Cover and Land Cover Change databases [21]. The proportion of artificial surface cover is remarkably high in some small western European countries. It reaches 12–14% in the Netherlands and Belgium, for instance [24]. In some regions of those countries, proportions are even higher: 29% of Flanders is covered by residential, industrial or service buildings; or vehicular infrastructure today [25].

Residential, industrial and service built-up areas alter the scenery radically and irreversibly usually. Landscape architects and urban infrastructure managers drew attention to hazards caused by limitless urban growth long ago [14,26,27]. The most serious problem is increasing traffic intensity; the carbon footprint grows by leaps and bounds [28]. Due to higher consumer demands, the estate market turns to 'urban infrastructure rural tranquility' type locations more or less separated from high-density residential areas [29–33]. This new approach is reflected in some recent terms such as rurbanization, edge-city, post-suburban landscapes, etc. [6,34,35]. The establishment of a living environment absolutely free from disturbances is hindered by the need for some 'not residential friendly' services close to the settlement due to economic reasons. Waste and wastewater management facilities and airports are practically impossible to be integrated into the landscape harmonically. Recent social expectations are reflected well in the name industrial 'parks' for industrial facilities along the margins of the settlements; that is, citizens do not want to see large concrete surfaces even in the industrial areas [23].

Considering the realignment of land use structure in peri-urban open spaces of towns, the emotional reactions of citizens have grown in importance recently. As accelerated urban lifestyle is becoming uniform and growing away from the natural environment, there has been a spectacular rise in the demand for a receptive environment that provides emotional stability [29,36–38]. In the midst of stressful situations, a relatively unaltered environment that transmits constancy and permanence has a favorable effect. The everyday visual connection to the physical environment can increase or decrease the feeling of familiarity and effects manifested in identity and safeness [39–41].

Research in the field of the so-called environmental psychology has seen spectacular development in Europe during the last 20–30 years [9,42–44]. Its most popular topic was to distinguish between the environmental approach and landscape perception of tourists and citizens at the beginning. The landscaped environment has become a cultural field of ecosystem service in the frame of the recent change of paradigm [38]. Geography has dealt with landscape image research for a long time, but the classification of geographic landscapes takes into account some landscape forming factors that have an important role in the function of landscapes merely instead of their visual appearance. For instance, geology, soil types and underground waters have an indirect impact on landscape image only, while a relief, vegetation, built-up areas and surface water bodies have a rather strong influence on the visual appearance of landscapes. This way studying the visual and emotional perception of landscape character is a new field of landscape geography in Hungary [45].

The research is based on, among others, a RENATUR Interreg Europe project, which addresses the idea of a sustainable environment, focusing on the conservation of natural and landscape values in different regions (Saxony-Anhalt, Germany; Hajdú-Bihar County, Hungary; Flanders, Belgium; Basque Country, Spain; Gorenjska, Slovenia and Mazovia,

Poland) of the member states of the European Union [46]. The main aim of the policy instrument was clear, but an improved structural background is required with an appropriate approach, enhanced capacity and the potential to integrate enhanced governance of ecosystem services to conserve biodiversity. New methodologies to efficiently implement the preservation and maintenance tasks are also needed.

General Tendencies of Urbanization in Hungary

There are two fundamental factors that govern the changes in the spatial extent and the type of built-up areas in the settlements in Hungary. The first is that the population of Hungary is decreasing and concentrating more and more in towns and cities. There are villages on one side of the spectrum of Hungarian settlements that are aging, dying out or used for recreation in the summer season only. The population of 139 villages out of the 3154 Hungarian settlements is under 100 people. Most abandoned houses are not demolished in villages, which means that the decrease in built-up areas is due to the windup of stock raising and small industrial facilities in the peri-urban open spaces. The biggest cities are on the other pole of the development of the settlement hierarchy of Hungary, where the growth of spatial extent seems to be unstoppable. Agglomeration processes are highly accelerated in the region of the capital of Hungary, Budapest, but the coalescence of settlements along the main routes that drain the city is characteristic of several cities such as Szombathely, Győr, Szeged, Pécs and Debrecen [47]. Elements of the Cohesion Policy of the EU, which projects urban shrinkage, have not been detectable in Hungary yet [48,49].

The second—so-called post-Fordist—general feature of urban development [3] is the increasing need for a quality residence. It is characterized by more airy built-up areas, larger green spaces, location near water banks or artificial water bodies and distance from noisy, busy places. Therefore, the decrease in the population of Hungary does not result in a lower proportion of residential land use types. On the contrary, since there are green buffer zones established around gated communities in order to provide a peaceful environment, the extent of residential areas has been growing.

A significant increase in areas used for infrastructural purposes is a characteristic of land use changes. There was an increase from 390 to 440 km^2 in the spatial extent of public roads between 2004 and 2015, for instance, and the process has become even more intense since then. Construction of clearways, bypasses and parking lots has been trying to keep up with demands [16]. Such projects are problematic from ecological and visual aspects as they lead to permanent soil sealing, hampered drainage, obstructed infiltration and altered micro-climate. However, traffic mitigating and crowding moderating effects of such projects are usually temporary, and problems reoccur in 5–10 years' time. It is not accidental that the way how gated communities are integrated into the traffic network is fundamental in the conservation of the basic values and the tranquility of those sites. For this reason, the most effective measure is the exclusion of through traffic in the case of gated communities.

The conflict between landscape protection and increasing built-up areas is not a new phenomenon. The demand for rational and sparing use of land is tangible in the encouragement of brown field projects in the last decades [50,51]. There have been no spectacular results in this field in Hungary. In the case of new car manufacturing sites, green field projects are still especially dominant (Győr/Audi, Kecskemét/Mercedes, Debrecen/BMW).

The National Landscape Strategy of Hungary, accepted in 2017, frames the following targets for settlements:

- A less expansive, more compact settlement form is preferable;
- Functionally and aesthetically tidied 'settlement gate' (margins of the settlements along the main inlet roads primarily);
- A mosaic-like land use structure that preserves ecological corridors and enclosures in the peri-urban open spaces;
- Climate-friendly water retaining functions of settlements;
- A settlement scenery that conserves values and the historic structure.

2. Materials and Methods

In order to support value-preserving landscape protection management and development, we carried out an assessment of the land use structure and the tendencies of changes in seven selected small Hungarian towns in the spring of 2021. The seven towns selected in the environment of the city of Debrecen were: Berettyóújfalu, Hajdúnánás, Hajdúsámson, Hajdúszoboszló, Nádudvar, Tiszacsege and Vámospércs (Figure 1).

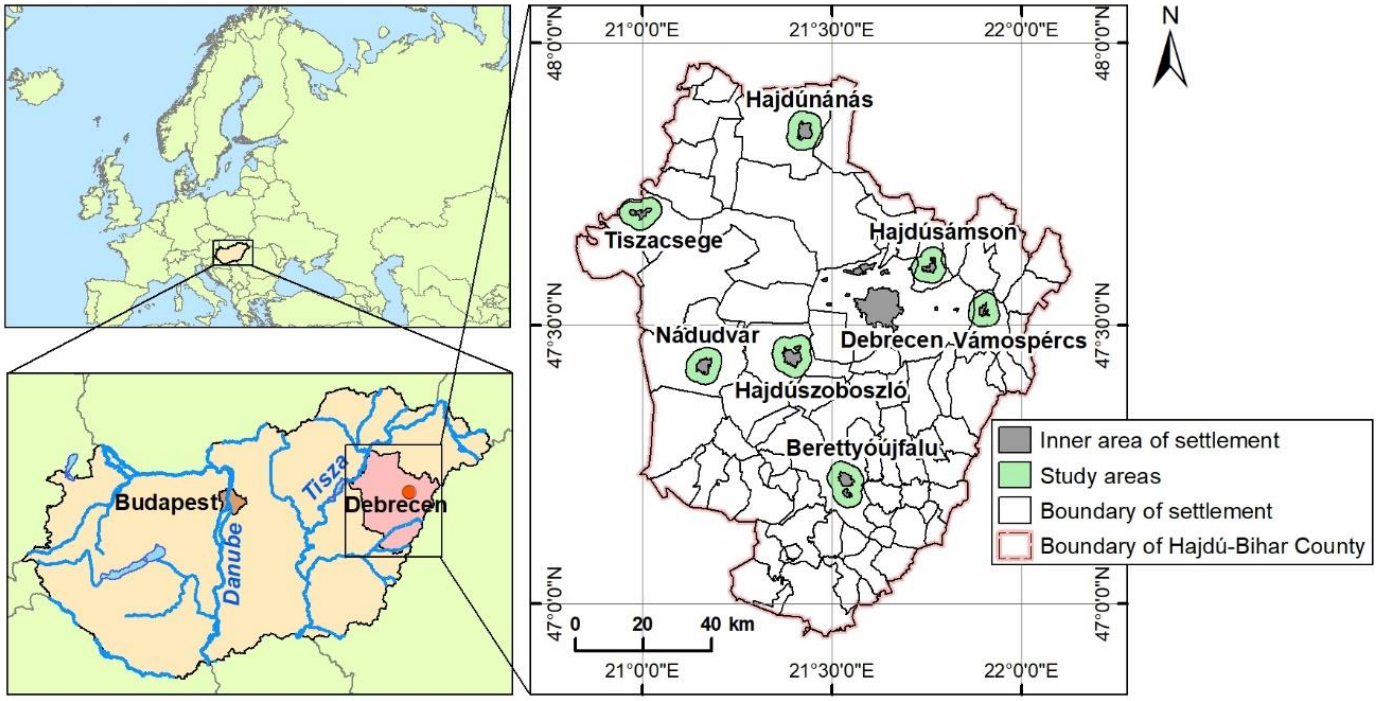

Figure 1. Location of the study areas in Hungary.

A belt with a width of 2 km is considered the peri-urban open space, as the authoritative Hungarian standard on landscape architecture specifies the analysis of a belt with this width [52–54].

1. Regulation plans, structural plans and so-called image documents of the settlements were analyzed;
2. Land use conversions were traced in the Copernicus Corine Land Cover and Land Cover Change database interpretations from 1990 [55], 2000 [56] and 2018 [57]. Changes in the inner parts of the settlements were not dealt with; therefore, the 2 km wide peri-urban open spaces were determined on the basis of the database from 1990. New built-up areas between 1990 and 2018 were not considered this way;
3. Land use categories of the Copernicus Corine Land Cover and Land Cover Change databases (in the hierarchical 3-level CLC nomenclature) proved to be too detailed [58–60]. Therefore, our own land use categories were created by aggregating the 28 categories that occur in Hungary (Table 1). In the case of vector databases with a scale of 1:100,000, the minimum mapped object size of 25 ha and the minimum width of 100 m for linear elements often provide insufficiently fine spatial resolution [55–58]. Since no other standardized databases were found in the international literature for the land use analysis of peri-urban open spaces [3,6,16,31], the examinations were carried out taking these technical constraints into account;
4. For analyzing the land use stability of peri-urban open spaces, the vector layers of the Copernicus Corine Land Cover and Land Cover Change databases were rasterized and subtracted from each other in reverse order (1990 was considered the base year). Land use changes in the different study areas and time periods were calculated based

on the area size (ha) and the proportion (%). For spatial data analyses and creating the thematic maps, ArcGIS 10.8 software was applied;

5. Corine data were checked during the field survey; a landscape character assessment was also made, which was compared to the results of a national-scale landscape character assessment completed in early 2021 [54].

Table 1. Correlation of the Corine nomenclature with our aggregated land use types [55–57].

Corine Nomenclature	Our Aggregated Land Use Types
1.1.1. Continuous urban fabric 1.2.1. Industrial or commercial units 1.2.2. Road and rail networks and associated land 1.2.3. Port areas 1.2.4. Airports	1. Densely built-up area and artificial surface
1.1.2. Discontinuous urban fabric 1.4.1. Green urban areas 1.4.2. Sport and leisure facilities	2. Discontinuous built-up area
1.3.1. Mineral extraction sites 1.3.2. Dump sites 1.3.3. Construction sites	3. Quarry and disposal site
2.1.1. Non-irrigated arable land 2.1.3. Rice fields	4. Arable land
2.2.2. Fruit trees and berry plantations 2.4.2. Complex cultivation patterns	5. Orchard
2.2.1. Vineyards	6. Vineyard
2.4.3. Land principally occupied by agriculture, with significant areas of natural vegetation	7. Mixed agricultural area
2.3.1. Pastures 3.2.1. Natural grasslands 3.3.3. Sparsely vegetated areas	8. Grassland
3.2.4. Transitional woodland-shrub	9. Bushes, transitional woodland
3.1.1. Broad-leaved forest 3.1.3. Mixed forest	10. Deciduous forest
3.1.2. Coniferous forest	11. Coniferous forest
4.1.1. Inland marshes 4.1.2. Peat bogs	12. Marshes
5.1.1. Water courses 5.1.2. Water bodies	13. Water bodies

The necessity of landscape character research is expressed in the European Landscape Convention accepted by Hungary in 2007: 'make an inventory of landscapes (identify the landscapes throughout their territories)' [61], and then also more accurately in the National Landscape Strategy. 'The list, description and presentation of landscapes based on their character (landscape inventory) is missing, just like the definition of the related quality objectives and regional planning which rely on them.' [62].

Landscape character research that has seen rapid development since the turn of the century focuses on the visual appearance of the environment and individuals' emotions and

perceptions related to it [45,63–66]. Most people are susceptible to change. Many people like the continuously altering environment, the appearance of new buildings, renewed parks, tidy forest patches and regulated water bodies. However, there are some landscape details and visual imprints living in everybody, the disappearance of which would cause a feeling of emotional loss [36,39,67]. If one cannot see the row of houses, the meandering creek and the forest patch from their childhood from one day to another, it would decrease the feeling of familiarity and the opportunity to relax the nerves in the long run [18,68]. 'Many people moved to urban areas and thus lost their bonds with their former landscape. The process of separation may be accelerated and further strengthened by the quick expansion of internet coverage and the difference between traditional values and those of the growing cyber generation. Globalization, as well as selling and consuming products produced in other countries instead of the locally produced ones, may also weaken bonds with the landscape and assist in losing identity. In an artificially supported economic environment, the knowledge of and skills in traditional landscape management lose their significance and gradually disappear.' [62].

3. Results and Discussion

The land use structure of the peri-urban open spaces in all the seven selected towns has seen different but significant changes during the last 30 years. Most remarkable alterations of structure and landscape character were found in the case of Hajdúsámson and Vámospércs, which are closest to Debrecen and have been developing into suburbs of the city (Figures 2–5).

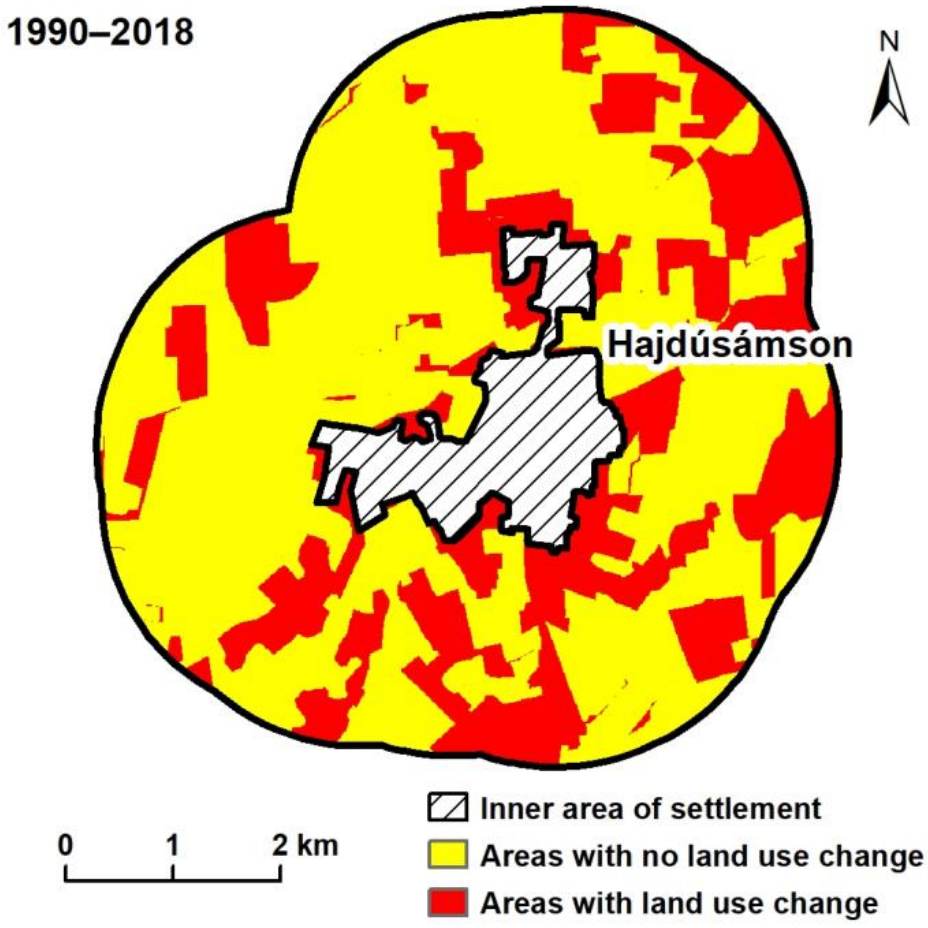

Figure 2. Land use change in the peri-urban zone of Hajdúsámson between 1990 and 2018.

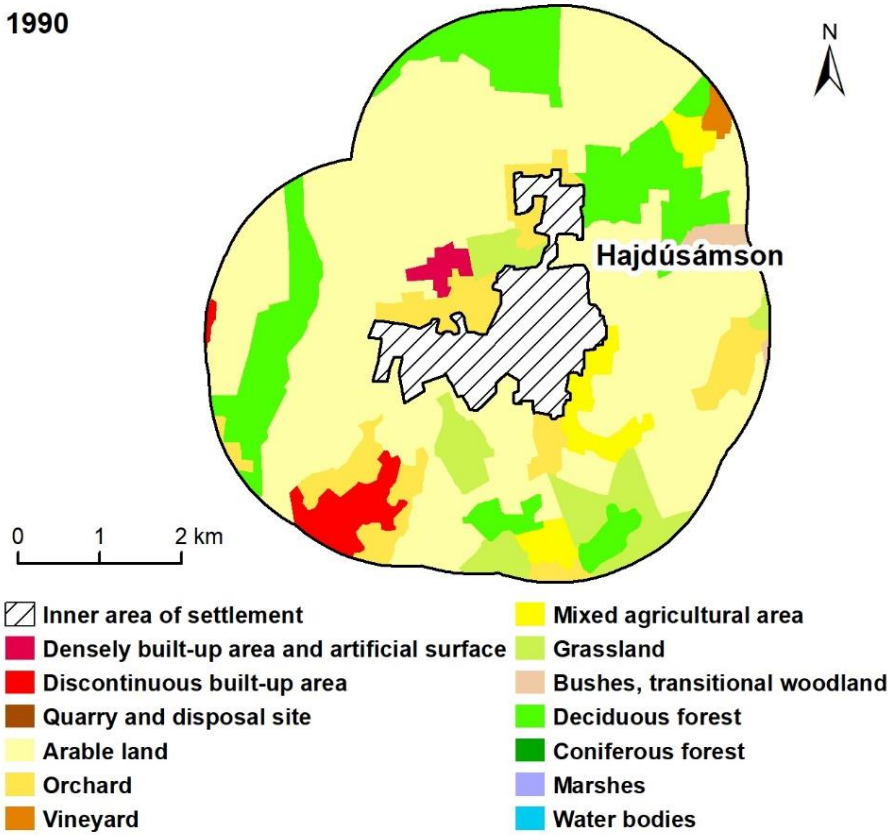

Figure 3. Land use in the peri-urban area of Hajdúsámson in 1990.

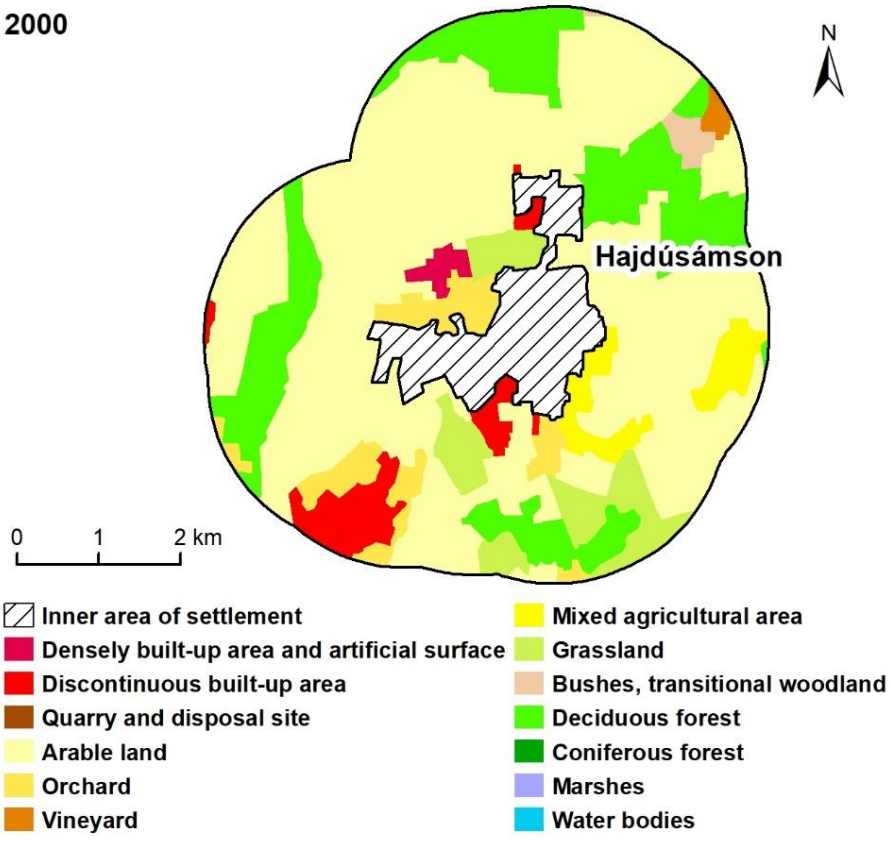

Figure 4. Land use in the peri-urban area of Hajdúsámson in 2000.

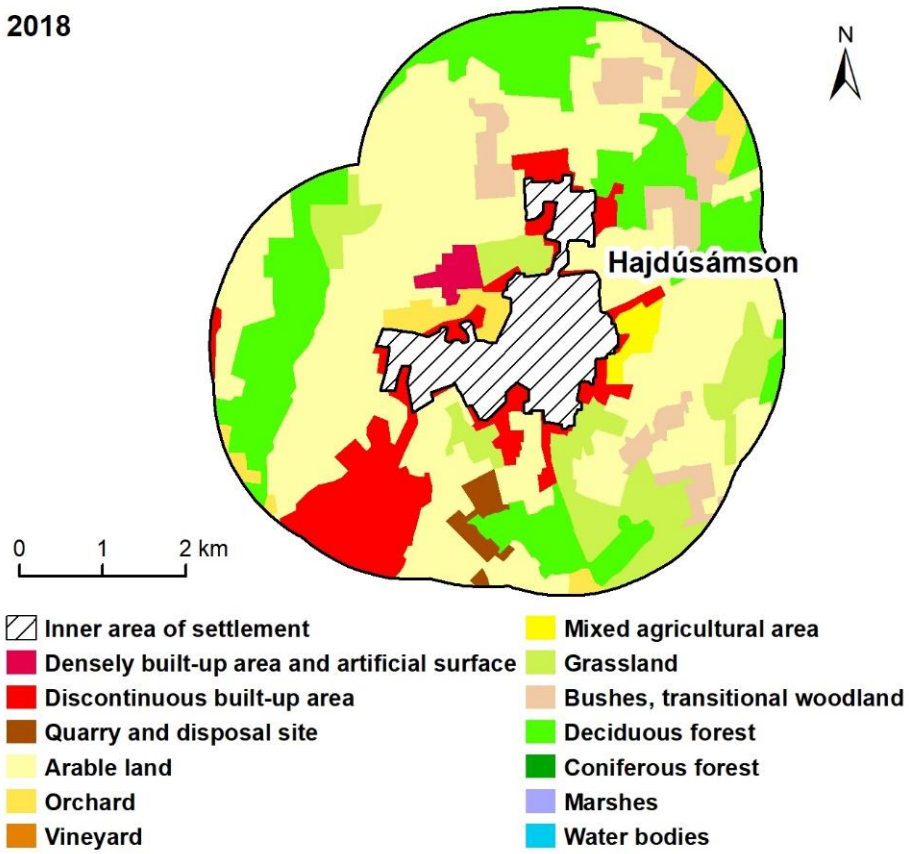

Figure 5. Land use in the peri-urban area of Hajdúsámson in 2018.

Surface cover type changed on 44.5% and 42.4% of the area of the 2 km wide peri-urban open spaces of Hajdúsámson and Vámospércs, respectively, during the 28-year-long period dealt with here (Table 2). Suburbs of big cities are considered a special type within the category of built-up areas in the neighborhood of settlements from both demographic and morphologic aspects [69–71]. Residential and industrial built-up was the most intense in the SSW marginal zone of Hajdúsámson, i.e., in the vicinity of the road to Debrecen (Figure 5: 2018). The urban fringe has widened, and the agglomeration process reached a high level. It is visible that industrial and logistical facilities were established mainly along the busy road to Debrecen instead of residential buildings. New residences are situated at a distance of a few hundred meters away from the main road. This tendency is in accordance with the general ambition of citizens who move to the vicinity of big cities as they seek a combination of an urban lifestyle and a rural environment. Their aim is to find space and calm locations with urban infrastructure [72]. Such places are attractive only until the growth of the residential areas and heavier traffic 'import' the urban disadvantages such as crowding, noise and air pollution [3,44,73,74]. In order to avoid this, a reasonable measure is to limit the size and housing density of gated communities together with the conservation of close-to-nature land use types such as forest patches, water bodies and grasslands in the neighborhood of gated communities [70,75].

There were also significant changes in land use structure in the areas NE of Hajdúsámson (Figures 2, 3 and 5). Since agriculture on sandy soils had not previously been highly profitable, agriculture has seen the most serious decrease in such regions over the whole country. The proportion of arable lands decreased from 60% to 47% in the close vicinity of Hajdúsámson over the study period. In addition to built-up areas, forest plantations and scrublands have occupied the place of formerly arable lands. The strengthening of the suburban character is reflected in the decrease in areas registered as gardens from 8.8% to 3% between 1990 and 2018. Additionally, former vineyards have completely disappeared. New built-up areas have occupied the area of former gardens mainly. The tendency that

there is no need for a stable behind the house and a small plot of arable land at the end of the stance has led to the homogenization of the residential areas. The extent of open grassland space between the houses has increased at the same time.

Table 2. Changes in the area and proportion of land use types in the peri-urban open spaces of Hajdúnánás, Hajdúsámson and Tiszacsege between 1990 and 2018.

Peri-Urban Zones	Land Use Types	Area (ha)			Proportion (%)		
		Year			Year		
		1990	2000	2018	1990	2000	2018
Hajdúnánás	Densely built-up area and artificial surface	28.13	28.13	47.88	0.77	0.77	1.31
	Discontinuous built-up area	0.00	14.24	39.84	0.00	0.39	1.09
	Quarry and disposal site	0.00	0.00	0.00	0.00	0.00	0.00
	Arable land	2369.93	2432.75	2438.26	64.78	66.49	66.64
	Orchard	287.09	237.38	235.46	7.85	6.49	6.44
	Vineyard	0.00	0.00	0.00	0.00	0.00	0.00
	Mixed agricultural area	84.89	0.00	0.00	2.32	0.00	0.00
	Grassland	761.01	809.39	749.16	20.80	22.12	20.48
	Bushes, transitional woodland	0.00	0.00	0.00	0.00	0.00	0.00
	Deciduous forest	0.00	0.00	0.00	0.00	0.00	0.00
	Coniferous forest	0.00	0.00	0.00	0.00	0.00	0.00
	Marshes	32.14	44.75	44.63	0.88	1.22	1.22
	Water bodies	95.45	92.01	103.43	2.61	2.51	2.83
	Total	**3658.65**	**3658.65**	**3658.65**	**100.00**	**100.00**	**100.00**
Hajdúsámson	Densely built-up area and artificial surface	26.37	26.37	32.29	0.78	0.78	0.95
	Discontinuous built-up area	86.48	136.65	348.00	2.55	4.03	10.27
	Quarry and disposal site	0.00	0.00	38.44	0.00	0.00	1.13
	Arable land	2038.14	2038.24	1584.76	60.15	60.16	46.77
	Orchard	298.18	185.06	102.79	8.80	5.46	3.03
	Vineyard	15.00	15.01	0.00	0.44	0.44	0.00
	Mixed agricultural area	122.00	116.33	32.54	3.60	3.43	0.96
	Grassland	226.79	218.70	331.70	6.69	6.45	9.79
	Bushes, transitional woodland	40.95	29.15	226.27	1.21	0.86	6.68
	Deciduous forest	534.36	622.77	691.48	15.77	18.38	20.41
	Coniferous forest	0.00	0.00	0.00	0.00	0.00	0.00
	Marshes	0.00	0.00	0.00	0.00	0.00	0.00
	Water bodies	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**3388.28**	**3388.28**	**3388.28**	**100.00**	**100.00**	**100.00**
Tiszacsege	Densely built-up area and artificial surface	35.70	35.70	35.04	0.99	0.99	0.97
	Discontinuous built-up area	65.01	73.89	140.41	1.80	2.04	3.88
	Quarry and disposal site	0.00	0.00	0.00	0.00	0.00	0.00
	Arable land	2325.34	2364.85	2274.29	64.32	65.41	62.91
	Orchard	33.97	0.00	25.29	0.94	0.00	0.70
	Vineyard	30.34	30.34	0.00	0.84	0.84	0.00
	Mixed agricultural area	0.00	0.00	0.00	0.00	0.00	0.00
	Grassland	660.54	628.04	657.15	18.27	17.37	18.18
	Bushes, transitional woodland	21.05	54.65	48.31	0.58	1.51	1.34
	Deciduous forest	371.48	355.96	363.10	10.28	9.85	10.04
	Coniferous forest	0.00	0.00	0.00	0.00	0.00	0.00
	Marshes	0.93	0.93	0.93	0.03	0.03	0.03
	Water bodies	70.90	70.90	70.72	1.96	1.96	1.96
	Total	**3615.26**	**3615.26**	**3615.26**	**100.00**	**100.00**	**100.00**

The land use structure of the towns situated on the loess plateau of Hajdúhát was found to be much more stable than in the case of towns in the sandy region mentioned above. Land use conversions occurred in 7–9% of the area of the peri-urban open spaces of

the settlements in the case of Hajdúnánás, Hajdúszoboszló and Nádudvar. The high-quality arable lands kept their dominant structural and visual role. New built-up areas increased the area of Hajdúszoboszló, especially the new holiday resorts attached to the thermal spa. A smaller increase in the extent of industrial and logistical facilities was also detected in the peri-urban zone of Hajdúszoboszló. The spa is situated in the marginal zone of the town, also in the case of Hajdúnánás. The small holiday resort in its vicinity has also been growing continuously.

Land use conversions, including the new built-up areas, have been concentrated over this western peri-urban zone of the settlement (Figure 6). Land use is highly homogenous in the peri-urban open spaces of all three towns. The proportion of arable lands and grasslands reaches 90% in the case of Hajdúnánás and Nádudvar, while it is slightly lower (70%) in Hajdúszoboszló, where gardens with a spatial extent of 8.8% have a role in slightly higher diversity. The development of bigger homogenous arable land plots results in a continuous decrease in landscape ecological patch diversity.

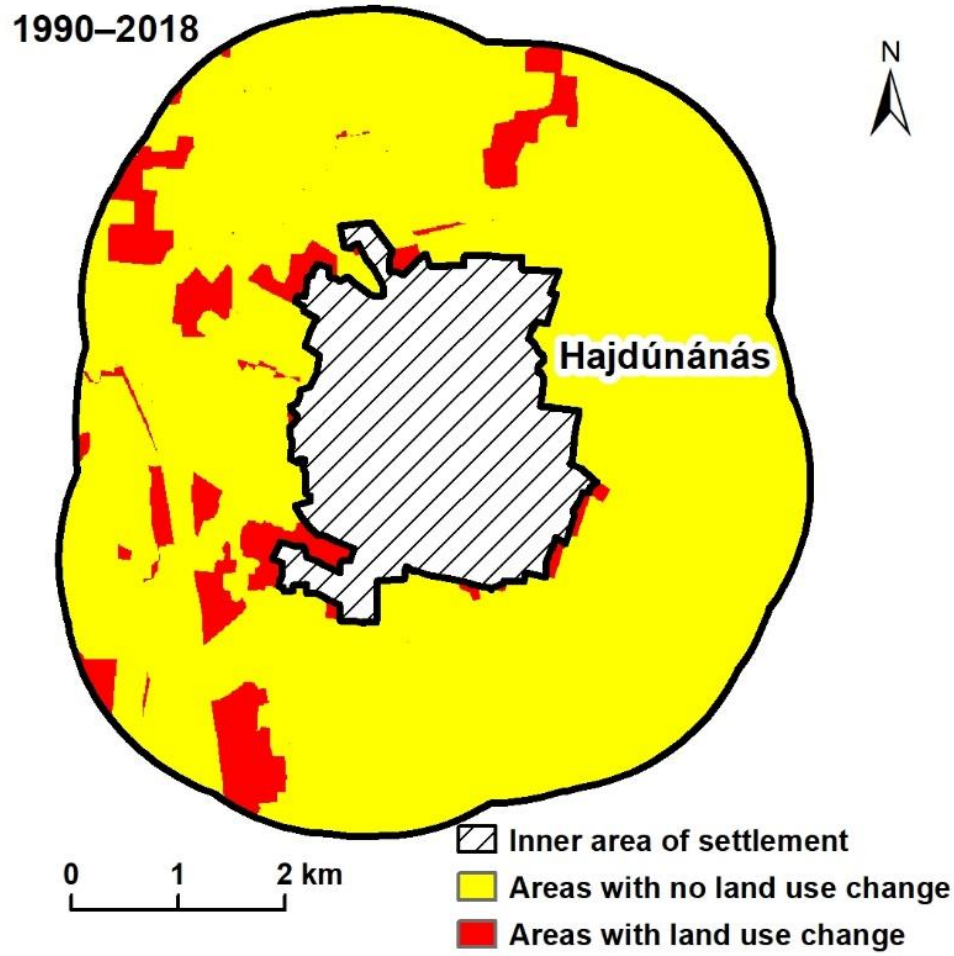

Figure 6. Land-use change in the peri-urban zone of Hajdúnánás between 1990 and 2018.

The common feature of Tiszacsege and Berettyóújfalu is that they are towns situated on a river bank, but they have a peripheral position. River bank position does not provide a direct connection; they are established on levees rising from a former alluvial plain, essentially. There were slight changes in the land use structure of the peri-urban open spaces of the two settlements during the last three decades, with conversions in cropping patterns over only 5–6% of the area (Figure 7).

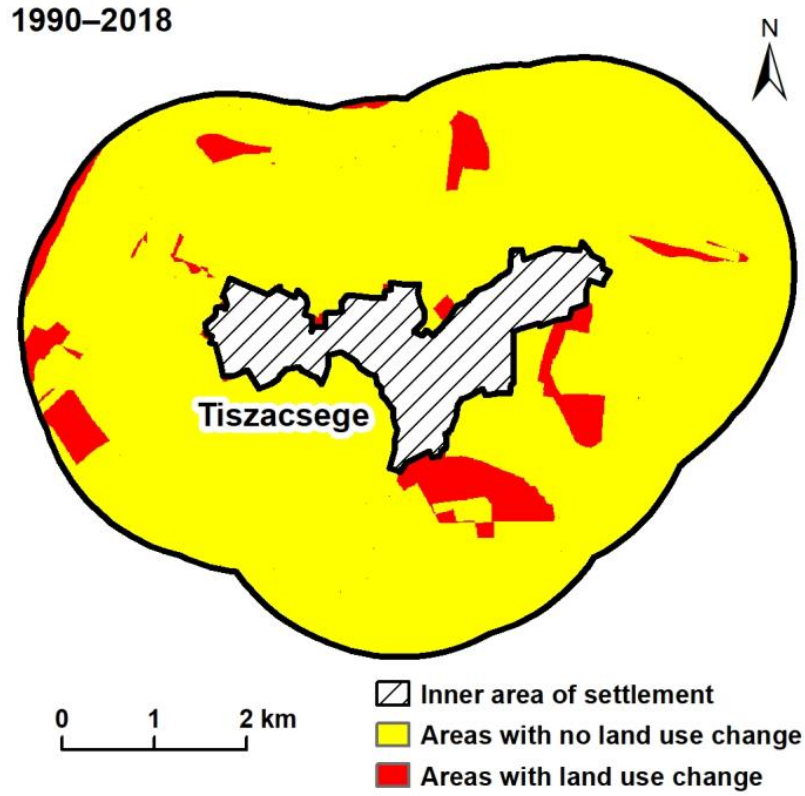

Figure 7. Land use change in the peri-urban zone of Tiszacsege between 1990 and 2018.

Western expansion of Tiszacsege towards River Tisza was accelerated by the establishment of a holiday resort consisting of 80–100 bungalows around the thermal spa in the late 1960s. Development of the resort has ceased since the 1990s, and most of the bungalows are on sale and are in rather untended condition. There is a small industrial park established in the S-SE peri-urban zone of the town. All other land use conversions are the result of shifts in land use designation (Figure 8). Some arable land plots were abandoned, and they developed into scrubland or grassland fallows. In the southern peri-urban zone of Berettyóújfalu, there are forest patches and gardens with greenhouses along the river, but the proportion of gardens has been stagnating or slightly decreasing.

There are landscape units in the peri-urban open spaces of each town involved in our research, where conservation of landscape character was guaranteed by local or national level nature protection. These mainly grassland or wetland (alkaline or floodplain) habitats occupy 10–15% of the total research area.

Buildings in the peri-urban open spaces of the settlements involved in our research have no specific character, and there are no signs of efforts to form a characteristic 'town gate' either. There are protected houses used as folklore museums at each settlement, traditional farmer and citizen buildings and streets that are in the so-called municipal image manual [76], but such buildings are situated in the center of the settlements with almost no exceptions. The style of residential buildings that shape the image of the peri-urban open spaces of the towns is not different from that of fashionable building types that can be found anywhere else. Some small steps forward would be the demolition of dilapidated stables and other buildings of collective farms of the socialist era and the green color and relatively nice-looking appearance of new industrial buildings, which would fit more in the landscape. Municipal image manuals focus only on parking, paving of public spaces and establishment of street furniture yet, but there are efforts for the conservation of traditional settlement structures such as the street network of Tiszacsege shaped by the form of a levee or the regular street network of Hajdúnánás that consists of radial and circular streets, for instance.

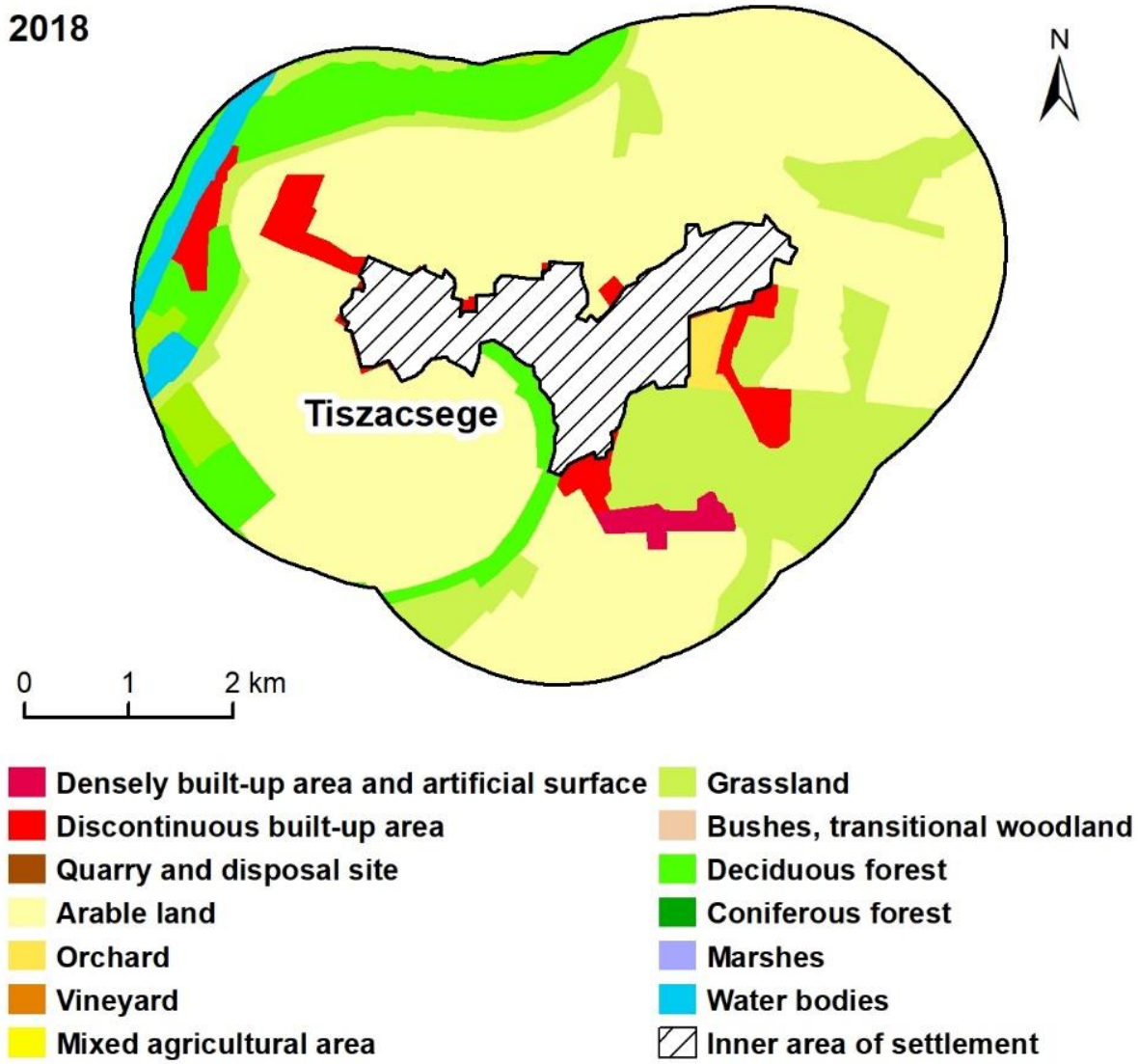

Figure 8. Land use in the peri-urban area of Tiszacsege in 2018.

On the basis of our field survey and the color orthophotos [77], we could prepare a much more detailed description of the landscape character compared to the national landscape character map. There had been no need for the determination of new landscape character types, but there had been some types delineated in our greater scale map that could not be visualized in the national map due to its smaller scale. Visual landscape experience requires a minimal spatial extent; therefore, a patch with a diameter of 1–200 m cannot be considered an individual landscape character type area. Our visual survey has considered a foreground of the sight up to a 500 m depth as an area where clearly visible details of the landscape form a characteristic entity together [52].

As an expressive comparison, we present here the landscape character map of the peri-urban open spaces of Hajdúnánás (Figure 9). We identified five types during the detailed field survey. There are peri-urban gardens, arable land-dominated patches but small plot mosaic patches, and mixed, which are also built-up–agricultural–grassland mosaics. The spread of the built-up areas is minimal on the eastern side of the town, where there are chernozem soils.

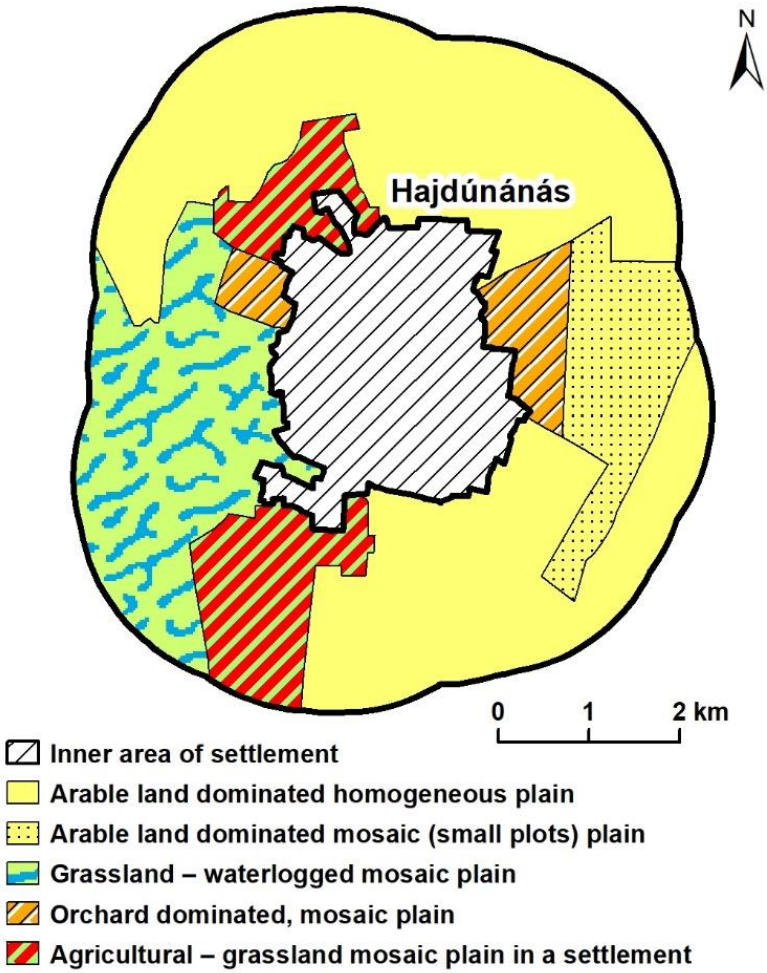

Figure 9. Landscape characteristics map of the peri-urban area of Hajdúnánás.

The attachment of citizens to the landscape is most strongly correlated to character types. In order to identify the landscape character types, a landscape character map is a more suitable tool than a Corine interpretation based on land use types, for example. Key elements in the attachment of citizens to the landscape in the towns of our study are the following:

1. Wet meadows and small water flows;
2. Close-to-natural (not planted!) forest patches;
3. Gardens.

Almost all towns in our study area have been encircled by wet meadow patches, old orchards, forest patches and weekend gardens which are part of the collective memory. Those citizens have an especially strong emotional attachment to them, who lived there in their childhood (site of great childhood 'adventures', Grandpa's garden, etc.)

Protection and rehabilitation of such landscape elements important for the conservation of identity have already appeared in some settlement development plans.

The vanishing of gardens caused a serious loss of identity in the case of Hajdúnánás, Hajdúsámson and Vámospércs. In the peri-urban zone of Hajdúszoboszló, the mixed small plot cropping pattern has been transformed by recreation as the number of holiday houses increased on former agricultural plots in the NW peri-urban zone of the town.

There was a sharp decrease in the extent of traditional land use types of the peri-urban open spaces of towns characterized by a combination of scrubby wetland habitats, wet meadows and small arable land plots.

The natural way of maintenance and use of grasslands would be an expansion of grazing, but there is hardly any sign of it in the environment of the studied settlements; moreover, the area used for grazing has been decreasing continuously.

The main aim of the research was to provide suggestions for sustainable ecological urban planning on the value of preserving the use of the environment of towns. According to this, we have delineated those landscape units in the peri-urban open spaces of each town, where we considered landscape protection interventions justified on the basis of the character and function of the individual landscape units in the ecological structure. These landscape units in peri-urban open spaces of the towns are worth special attention and have been delineated in the more mosaic-like areas of the settlements preserving the original characters consisting of small plots of arable lands, grasslands, natural water bodies and gardens, similarly to the example of Nádudvar presented in Figure 10.

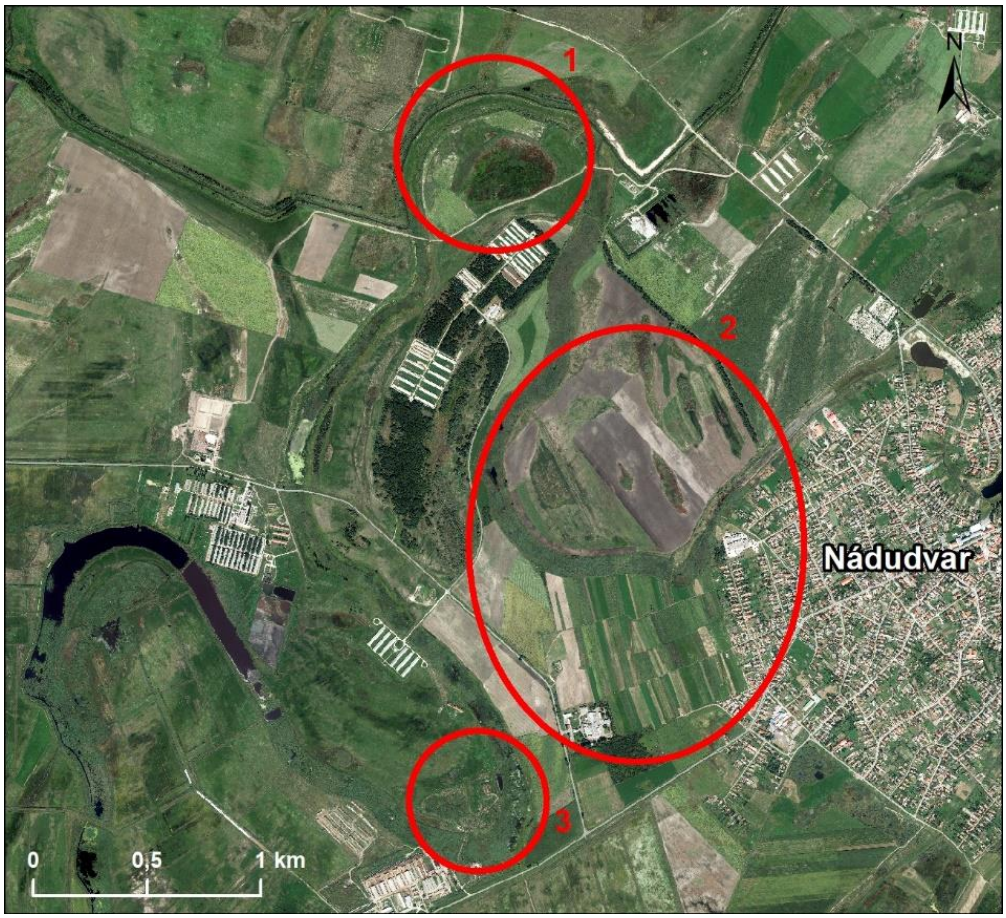

Figure 10. Landscape character areas recommended for preservation on the outskirts of Nádudvar [77]. 1: Mosaic grassland; 2: Agricultural landscape with small plots of arable land and waterlogged meadows; 3. Mosaic grasslands with lakes.

4. Conclusions

Expansion of built-up areas and a high proportion of arable lands are general trends in the peri-urban open spaces of each studied settlement. Land use conversions had the most disadvantageous effect on small plots of arable land and also gardens belonging to a receding type. This trend, however, is not true everywhere at the national level. There are small towns that do not grow territorially, and in some places, arable farming is also declining primarily due to demographic and economic reasons. At best, afforestation is carried out on the site of arable lands. The trend is even less generalizable at the regional level: the depopulation of rural areas is mainly a phenomenon in Eastern and Southern Europe [16,78] but less prevalent in the western part of the continent [49].

The general Hungarian and European trend regarding afforestation is only moderate in the study areas [11,74]. The reason for this is that forest management requires greater care due to the dry climate of the study areas. There was an increase of 2–3% in the spatial extent of grasslands in the case of three small towns, while other settlements observed a decrease of 2–3%. The spread of grasslands serves nature protection purposes almost exclusively and not livestock production demands.

The simplification of the land use pattern of peri-urban open spaces of towns enhances visual monotony. Tree rows and forest belts along dirt roads have been disappearing from the landscape [53]. Built-up areas and afforested units of the landscape are becoming more compact, while the vicinity of large plots of arable lands is becoming more open. Therefore, the contrast between individual sectors of the landscape has become sharper. Modern gated communities appear mosaic-like, with abandoned, weedy arable land patches among them. Identity-enhancing elements of landscape character are wet meadows, small water flows, close-to-natural (not planted!) forest patches, gardens and orchards. There has only been little positive change regarding the quality of built-up areas in the peri-urban open spaces of towns; the development of an attractive town gate is not typical.

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References

1. Allen, A. Environmental planning and management of the peri-urban interface: Perspectives on an emerging field. *Environ. Urban.* **2003**, *15*, 135–148. [CrossRef]
2. Egedy, T. Strategic and Socio-Economic Implications of Urban Regeneration in Hungary. In *Development of the Settlement Network in the Central European Countries: Past, Present, and Future*; Csapó, T., Balogh, A., Eds.; Springer: Berlin/Heidelberg, Germany, 2012; pp. 145–160. [CrossRef]
3. Kovács, Z.; Farkas, Z.J.; Egedy, T.; Kondor, A.C.; Szabó, B.; Lennert, J.; Baka, D.; Kohán, B. Urban sprawl and land conversion in post-socialist cities: The case of metropolitan Budapest. *Cities* **2019**, *92*, 71–81. [CrossRef]
4. Piorr, A.; Ravetz, J.; Tosics, I. *Peri-Urbanisation in Europe: Towards European Policy to Sustain Urban-Rural Futures*; University of Copenhagen: Copenhagen, Denmark, 2011; p. 144.
5. Antrop, M. Landscape change and the urbanization process in Europe. *Landsc. Urban Plan.* **2004**, *67*, 9–26. [CrossRef]
6. Barros, J.L.; Tavares, A.O.; Monteiro, M.; Santos, P.P. Peri-Urbanization and Rurbanization in Leiria City: The Importance of a Planning Framework. *Sustainability* **2018**, *10*, 2501. [CrossRef]
7. Kaimaris, D.; Patias, P. Identification and Area Measurement of the Built-up Area with the Built-up Index (BUI). *IJARSG* **2016**, *5*, 1844–1858. [CrossRef]

8. Lichter, D.T.; Ziliak, J.P. The Rural-Urban Interface: New Patterns of Spatial Interdependence and Inequality in America. *Ann. Am. Acad. Political Soc. Sci.* **2017**, *672*, 6–25. [CrossRef]
9. Roose, A.; Kull, A.; Gauk, M.; Tali, T. Land use policy shocks in the post-communist urban fringe: A case study of Estonia. *Land Use Policy* **2013**, *30*, 76–83. [CrossRef]
10. Tacoli, C. The links between urban and rural development. *Environ. Urban.* **2003**, *15*, 3–12. [CrossRef]
11. Balta, S.; Atik, M. Rural planning guidelines for urban-rural transition zones as a tool for the protection of rural landscape characters and retaining urban sprawl: Antalya case from Mediterranean. *Land Use Policy* **2022**, *119*, 106144. [CrossRef]
12. Hersperger, A.M.; Bürgi, M. Going beyond landscape change description: Quantifying the importance of driving forces of landscape change in a Central Europe case study. *Land Use Policy* **2009**, *26*, 640–648. [CrossRef]
13. Sheng, Y.K. Peri-urban transformations in Southeast Asia. In *Routledge Handbook of Urbanization in Southeast Asia*, 1st ed.; Padawangi, R., Ed.; Routledge: Abingdon, UK; New York, NY, USA, 2019; pp. 31–42.
14. Simon, D. Urban Environments: Issues on the Peri-Urban Fringe. *Annu. Rev. Environ. Resour.* **2008**, *33*, 167–185. [CrossRef]
15. Csorba, P.; Ádám, S.; Bartos-Elekes, Z.; Bata, T.; Bede-Fazekas, Á.; Czúcz, B.; Csima, P.; Csüllög, G.; Fodor, N.; Frisnyák, S.; et al. Landscapes. In *National Atlas of Hungary—Natural Environment*, 1st ed.; Kocsis, K., Gercsák, G., Horváth, G., Keresztesi, Z., Nemerkényi, Z., Eds.; MTA CSFK Geographical Institute: Budapest, Hungary, 2018; pp. 112–129.
16. Bański, J. The consequences of changes of ownership for agricultural land use in Central European countries following the collapse of the Eastern Bloc. *Land Use Policy* **2017**, *66*, 120–130. [CrossRef]
17. Grădinaru, S.R.; Iojă, C.I.; Onose, D.A.; Gavrilidis, A.A.; Pătru-Stupariu, I.; Kienast, F.; Hersperger, A.M. Land abandonment as a precursor of built-up development at the sprawling periphery of former socialist cities. *Ecol. Indic.* **2015**, *57*, 305–313. [CrossRef]
18. Kubeš, J.; Novácek, A. Suburbs around the Czech provincial city of České Budějovice—Territorial arrangement and problems. *HunGeoBull* **2019**, *68*, 65–78. [CrossRef]
19. Lennert, J.; Csatári, B.; Farkas, J.Z.; Mezőszentgyörgyi, D. Locality-Based and Place-Based Development in Theory and Practice—An Example of the Hungarian Countryside. *DETUROPE* **2015**, *7*, 14–27. [CrossRef]
20. Oșlobanu, C.; Alexe, M. Built-up area analysis using Sentinel data in metropolitan areas of Transylvania, Romania. *HunGeoBull* **2021**, *70*, 3–18. [CrossRef]
21. Lennert, J. Felszínborítás-változás a visegrádi országokban a rendszerváltás után. *Magy. Tud.* **2018**, *3*, 319–330. [CrossRef]
22. Doucha, T.; Divila, E. Changes in Czech agriculture in the years 1990–2005. *Studia Obsz. Wiej.* **2008**, *15*, 73–95.
23. Jackson, J.; Garb, Y. *Facilitating Brownfield Redevelopment in Central Europe: Overview and Proposals*; Institute for Transport and Development Policy: New York, NY, USA, 2002; pp. 1–17.
24. OECD. Land Cover Change in Countries and Regions: Conversion of Cropland to Artificial Surfaces. Available online: https://stats.oecd.org/ (accessed on 1 March 2022).
25. Statistics Flanders. Land Use: Built-Up Area. Available online: https://www.vlaanderen.be/en/statistics-flanders/land-use/built-up-area (accessed on 1 March 2022).
26. Geddes, R. Metropolis unbound: The sprawling American city and the search for alternatives. *Am. Prospect.* **1997**, *35*, 40–46.
27. Šveda, M.; Vigašová, D. Land use change in the hinterland of major Slovak cities. *Geografie* **2010**, *115*, 413–439. [CrossRef]
28. Szigeti, C.; Kovács, Z.; Egedy, T.; Szabó, B. Az ingázásból származó ökológiai lábnyom csökkentésének lehetőségei a közösségi gazdaság révén a budapesti városrégióban. *Közlekedéstudományi Szle.* **2019**, *69*, 58–74. [CrossRef]
29. Antrop, M.; Van Eetvelde, V. *Landscape Perspectives: The Holistic Nature of Landscape*; Springer: Dordrecht, The Netherlands, 2017; Volume 23, p. 436. [CrossRef]
30. Bryant, C.R.; Charvet, J.P. La zone périurbaine : Structure et dynamiques d'une composante stratégique des régions métropolitaines. *Can. J. Reg. Sci.* **2003**, *26*, 241–250.
31. Izakovičová, Z.; Petrovič, F.; Pauditšová, E. The Impacts of Urbanisation on Landscape and Environment: The Case of Slovakia. *Sustainability* **2021**, *14*, 60. [CrossRef]
32. Kondor, A. Helyi konfliktusok Budapest szuburbán zónájában. *Földrajzi Közlemények* **2016**, *140*, 216–228.
33. Nardino, M.; Laruccia, N. Land Use Changes in a Peri-Urban Area and Consequences on the Urban Heat Island. *Climate* **2019**, *7*, 133. [CrossRef]
34. Adell, G. Theories and models of the peri-urban interface: A changing conceptual landscape. In *Development Planning Unit*; UCL: London, UK, 1999; p. 46.
35. Zgliński, W. The essential problems and the structure of Polish agriculture in the period of transformation. *Studia Obsz. Wiej.* **2008**, *15*, 45–72.
36. Pedroli, G.B.M. *Landscape—Our Home*; Essays on the Culture of the European Landscape as a Task; Indigo: Zeist, The Netherlands, 2000; p. 222.
37. Pedroli, B.; van Doorn, A.; de Blust, G.; Paracchini, M.L.; Wascher, D.; Bunce, F. (Eds.) *Europe's Living Landscapes: Essays Exploring Our Identity in the Countryside*; KNNV Publishing: Zeist, The Netherlands, 2007; p. 432.
38. Raymond, R.; Luginbühl, Y.; Seguin, J.F.; Cedelle, Q.; Grare, H. *Landscape Atlases: Landscape Identification, Characterisation and Assessment Method*; Ministère de l'Écologie, du Développement durable et de l'Énergie: Paris, France, 2015; p. 111.
39. Csorba, P.; Csatári, B. Tájföldrajz és táji önazonosság. *Magy. Tud.* **2017**, *3*, 284–292.
40. Scott, M.J.; Canter, D.V. Picture or place? A multiple sorting study of landscape. *J. Environ. Psychol.* **1997**, *17*, 263–281. [CrossRef]

41. Simensen, T.; Halvorsen, R.; Erikstad, L. Methods for landscape characterisation and mapping: A systematic review. *Land Use Policy* **2018**, *75*, 557–569. [CrossRef]
42. Devine-Wright, P.; Quinn, T. Dynamics of Place Attachment in a Climate Changed World. In *Place Attachment: Advances in Theory, Methods and Applications*, 2nd ed.; Manzo, L.C., Devine-Wright, P., Eds.; Routledge: Abingdon, UK; New York, NY, USA, 2020; pp. 226–242.
43. Kaltenborn, B.P.; Williams, D.R. The meaning of place: Attachments to Femundsmarka National Park, Norway, among tourists and locals. *Nor. J. Geogr.* **2002**, *56*, 189–198. [CrossRef]
44. Kianicka, S.; Buchecker, M.; Hunziker, M.; Müller-Böker, U. Locals' and tourists' sense of place: A case study of a Swiss alpine village. *Mt. Res. Dev.* **2006**, *26*, 55–63. [CrossRef]
45. Konkoly-Gyuró, É.; Vaszócsik, V.; Csorba, P.; Schneller, K.; Jombach, S.; Boromissza, Z.; Erdei, T.; Balázs, P.; Kiss, D.; Teleki, M.; et al. Az országos tájkarakter-elemzés kezdetei Magyarországon. *Földrajzi Közlemények* **2021**, *145*, 193–208. [CrossRef]
46. RENATUR Brochure. Available online: https://projects2014-2020.interregeurope.eu/fileadmin/user_upload/tx_tevprojects/library/file_1579699605.pdf (accessed on 20 January 2022).
47. Beluszky, P.; Kovács, Z. Settlement system. In *National Atlas of Hungary—Society*, 1st ed.; Kocsis, K., Klinghammer, I., Nemerkényi, Z., Gercsák, G., Kincses, Á., Kovács, Z., Tóth, G., Zentai, L., Eds.; CSFK Geographical Institute: Budapest, Hungary, 2021; pp. 108–115.
48. Egedy, T. A kelet-közép-európai városrégiók átalakulása a posztfordi korban—elméleti alapok. *Földrajzi Közlemények* **2021**, *145*, 354–368. [CrossRef]
49. Taubenböck, H.; Gerten, C.; Rusche, K.; Siedentop, S.; Wurm, M. Patterns of Eastern European urbanisation in the mirror of Western trends—Convergent, unique or hybrid? *Environ. Plan. B Urban Anal. City Sci.* **2019**, *46*, 1206–1225. [CrossRef]
50. Faragó, P.; Koncz, G. Felhagyott mezőgazdasági és ipari telephelyek hasznosításának lehetőségei a Gyöngyösi kistérségben. *Acta Carolus Robertus* **2012**, *2*, 23–31. [CrossRef]
51. Kádár, K. Barnamezők Magyarországon. *DETUROPE* **2011**, *3*, 122–141. [CrossRef]
52. Hungarian Standards Institution. *Nature Protection. Aesthetec Evaluation of Landscapes MSZ 20372:2004*; Hungarian Standards Institution: Budapest, Hungary, 2004; pp. 1–17.
53. Wallace, K.J. Classification of ecosystem services: Problems and solutions. *Biol. Conserv.* **2007**, *139*, 235–246. [CrossRef]
54. Konkoly-Gyuró, É.; Vaszócsik, V.; Sain, M.; Csorba, P.; Csőszi, M. *Landscape Character Research in Hungary*; Ministry of Ag-riculture: Budapest, Hungary, 2021; pp. 1–48.
55. Copernicus Land Monitoring Service. Corine Land Cover 1990. Available online: https://land.copernicus.eu/pan-european/corine-land-cover/clc-1990 (accessed on 10 February 2022).
56. Copernicus Land Monitoring Service. Corine Land Cover 2000. Available online: https://land.copernicus.eu/pan-european/corine-land-cover/clc-2000 (accessed on 10 February 2022).
57. Copernicus Land Monitoring Service. Corine Land Cover 2018. Available online: https://land.copernicus.eu/pan-european/corine-land-cover/clc2018 (accessed on 10 February 2022).
58. Szabó, S. A CLC2000 és CLC50 adatbázisok összehasonlítása tájmetriai módszerekkel. *Tájökológiai Lapok* **2010**, *8*, 23–33.
59. Szilassi, P. Magyarországi kistájak felszínborítás változékonysága és felszínborítás mozaikosságuk változása. *Tájökológiai Lapok* **2017**, *15*, 131–138.
60. Németh, G.; Lóczy, D.; Gyenizse, P. Long-Term Land Use and Landscape Pattern Changes in a Marshland of Hungary. *Sustainability* **2021**, *13*, 12664. [CrossRef]
61. Council of Europe. *European Landscape Convention and Reference Documents*; Council of Europe Publishing Division: Strasbourg, France, 2000; p. 94. Available online: https://www.iflaeurope.eu/assets/docs/European_Landscape_Convention-Txt-Ref_en.pdf_.pdf (accessed on 27 January 2022).
62. Ministry of Agriculture. *Hungarian National Landscape Strategy 2017-2026*; Department of National Parks and Landscape Protection, Ministry of Agriculture: Budapest, Hungary, 2017; p. 75. Available online: https://2015-2019.kormany.hu/download/f/8f/11000/Hungarian%20National%20Landscape%20Strategy_2017-2026_webre.pdf (accessed on 3 February 2022).
63. Fairclough, G.; Herlin, I.S.; Swanwick, C. (Eds.) *Routledge Handbook of Landscape Character Assessment: Current Approaches to Characterisation and Assessment*, 1st ed.; Routledge: Abingdon, UK; New York, NY, USA, 2018; p. 294.
64. Swanwick, C. *Landscape Character Assessment. Guidance for England and Scotland*; The Countryside Agency: Gloucestershire, UK; Scottish Natural Heritage: Edinburgh, UK, 2002; p. 104.
65. Wascher, D.M. (Ed.) *European Landscape Character Areas—Typologies, Cartography and Indicators for the Assessment of Sustainable Landscapes*; No. 1254; Landscape Europe: Wageningen, The Netherlands, 2005; p. 148.
66. Koç, A.; Yılmaz, S. Landscape character analysis and assessment at the lower basin-scale. *Appl. Geogr.* **2020**, *125*, 102359. [CrossRef]
67. Belén, M.; Ortega, E.; Martino, P.; Otero, I. Inferring landscape change from differences in landscape character between the current and a reference situation. *Ecol. Indic.* **2018**, *90*, 584–593. [CrossRef]
68. Csorba, P. A földrajzi tájakhoz fűződő identitástudat rétegei. *Tájökológiai Lapok* **2010**, *8*, 3–21.
69. Egedy, T.; Kovács, Z.; Kondor, A.C. Metropolitan region building and territorial development in Budapest: The role of national policies. *Int. Plan. Stud.* **2017**, *22*, 14–29. [CrossRef]

70. Kovács, Z.; Hegedűs, G. Gated communities as new forms of segregation in post-socialist Budapest. *Cities* **2014**, *36*, 200–209. [CrossRef]
71. Vasárus, G.; Bajmócy, P.; Lennert, J. In the shadow of the city: Demographic processes and emerging conflicts in the rural-urban fringe of the Hungarian agglomerations. *Geogr. Pannonica* **2018**, *22*, 14–29. [CrossRef]
72. Ianos, I.; Sirodoev, I.; Pascariu, G. Land-use conflicts and environmental policies in two post-socialist urban agglomerations: Bucharest and Chișinău. *Carpathian J. Earth Environ. Sci.* **2012**, *7*, 125–136.
73. Miljković, J.Ž.; Crnčević, T.; Marić, I. Land use planning for sustainable development of peri-urban zones. *Spatium* **2012**, *28*, 15–22. [CrossRef]
74. Žoncová, M. Evaluation of the diversification of rural landscape in Slovakia after 1989 with a focus on the built-up area of municipalities: A case study of Podhájska municipality. *HunGeoBull* **2018**, *67*, 143–158. [CrossRef]
75. Cséfalvay, Z. Searching for Economic Rationale behind Gated Communities: A Public Choice Approach. *Urban Stud.* **2011**, *48*, 749–764. [CrossRef]
76. évi LXXIV. törvény a településkép védelméről. Available online: https://net.jogtar.hu/jogszabaly?docid=a1600074.tv (accessed on 7 February 2022).
77. Lechner Knowledge Center Non-Profit Limited Company. Colour Ortophotos (ID: 68-423, 79-112, 79-114, 79-121, 79-123) 2011. Available online: https://geoshop.hu/car (accessed on 19 February 2022).
78. Jiménez-Olivencia, Y.; Ibáñez-Jiménez, Á.; Porcel-Rodríguez, L.; Zimmerer, K. Land use change dynamics in Euro-mediterranean mountain regions: Driving forces and consequences for the landscape. *Land Use Policy* **2021**, *109*, 105721. [CrossRef]